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Presentation Title: The Ergonomics of Human Space Flight: NASA Vehicles and Spacesuits

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Abstract

Space…the final frontier…these are the voyages of the starship…wait, wait, wait…that's not right…let's try that again. NASA is currently focusing on developing multiple strategies to prepare humans for a future trip to Mars. This includes (1) learning and characterizing the human system while in the weightlessness of low earth orbit on the International Space Station and (2) seeding the creation of commercial inspired vehicles by providing guidance and funding to US companies. At the same time, NASA is slowly leading the efforts of reestablishing human deep space travel through the development of the Multi-Purpose Crew Vehicle (MPCV) known as Orion and the Space Launch System (SLS) with the interim aim of visiting and exploring an asteroid.

Without Earth's gravity, current and future human space travel exposes humans to micro- and partial gravity conditions, which are known to force the body to adapt both physically and physiologically. Without the protection of Earth's atmosphere, space is hazardous to most living organisms. To protect themselves from these difficult conditions, Astronauts utilize pressurized spacesuits for both intravehicular travel and extravehicular activities (EVAs). Ensuring a safe living and working environment for space missions requires the creativity of scientists and engineers to assess and mitigate potential risks through engineering designs. The discipline of human factors and ergonomics at NASA is critical in making sure these designs are not just functionally designed for people to use, but are optimally designed to work within the capacities specific to the Astronaut Corps. This lecture will review both current and future NASA vehicles and spacesuits while providing an ergonomic perspective using case studies that were and are being carried out by the Anthropometry and Biomechanics Facility (ABF) at NASA's Johnson Space Center.

Biographical Sketch

Dr. Christopher Reid is a graduate of the University of Central Florida (UCF) in Orlando, Florida, where he earned a Bachelor of Science in Electrical Engineering Technology (BSEET) with a focus in Computer Systems (2003), a Master of Science (MS) in Industrial Engineering with a focus in Engineering Management (2005), and a Doctor of Philosophy (PhD) in Industrial Engineering with a focus in Human Systems Engineering & Ergonomics (2009). His doctoral dissertation was based on developing a method for lower extremity musculoskeletal discomfort and disorder risk assessment. Dr. Reid is currently a Senior Human Factors Design Engineer for Lockheed Martin's Information Systems & Global Solutions (IS&GS) Civil Division where he works at NASA's Johnson Space Center (JSC) located in Houston, Texas. At JSC he is the Human Factors & Ergonomics Discipline Lead for the Anthropometry and Biomechanics Facility (ABF) which is part of the Biomedical Research and Environmental Sciences Division. In this position, he utilizes his experience in engineering, human factors, ergonomics, anthropometry, physiology, and biomechanics, to assess spacesuits, vehicles, and habitats in order to mitigate potential cumulative musculoskeletal disorders (MSD) and to improve human performance for their Astronaut users. Before working for Lockheed Martin, Dr. Reid gained human factors and ergonomics experience while working with personal protective equipment and garments as a Human Factors Engineer (civil servant) for the US Army Natick Soldier Research Development & Engineering Center (NSRDEC) in Natick, Massachusetts. Additionally, he was a graduate level Industrial Ergonomics Engineering Intern for several years working on reducing manufacturing related injuries for large aircraft manufacturing at Boeing Commercial Airplanes (BCA) in Everett, Washington. Dr. Reid is a member of the Human Factors & Ergonomics Society (HFES), the Institute of Industrial Engineers (IIE), the American Society of Biomechanics (ASB), and the Tau Beta Pi Engineering Honor Society. He is also a

reviewer for multiple publication journals such as the Applied Ergonomics Journal, the International Journal of Industrial Ergonomics (IJIE), and the Journal of Occupational and Environmental Medicine (JOEM).